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Describes procedures for testing shelters, tents, and their associated  
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US ARMY TEST AND EVALUATION COMMAND  
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-109

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AD No.

19 March 1984

TENTS AND SHELTERS

	<u>Page</u>
Paragraph 1. SCOPE. . . . .	1
2. FACILITIES AND INSTRUMENTATION . . . . .	1
3. REQUIRED TEST CONDITIONS . . . . .	2
4. TEST PROCEDURES. . . . .	3
4.1 Erection and Striking. . . . .	3
4.2 Structural Stability Tests . . . . .	5
4.3 Blackout Tests . . . . .	6
4.4 Illumination Tests . . . . .	10
4.5 Heating Tests. . . . .	11
4.6 Test Chamber Water Resistance Tests. . . . .	16
4.7 Durability . . . . .	17
4.8 Environmental. . . . .	18
4.9 Human Factors. . . . .	18
4.10 Logistic Supportability. . . . .	18
4.11 Safety . . . . .	19
5. DATA REQUIRED. . . . .	19
6. DATA PRESENTATION. . . . .	26

Appendix A. REFERENCES . . . . .	A-1
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1. SCOPE. This TOP provides procedures for determining the technical performance and safety characteristics of tents, shelters, and their associated tools/equipment, as specified in requirements documents. It does not cover special testing such as sound level, ventilation, etc.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

<u>ITEM</u>	<u>REQUIREMENT</u>
Platform scales	accuracy of 0.5 kg (1 lb)
Wind-producing machine	to maximum of 121 km/hr (75 mph)
Rain course	
Measuring tape	steel at least twice as long as maximum dimension of test item
Stopwatch	
Cameras/film	still and movie

\*This TOP supersedes MTP 10-2-175 dated June 1967.

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## 2.2 Instrumentation.

### DEVICE FOR MEASURING

### MAXIMUM PERMISSIBLE ERROR OF MEASUREMENT\*

Wind direction	<u>+1°</u>
Ambient wind velocity	<u>+0.8 km/hr (0.5 mph)</u>
Solar radiation	
Relative humidity	<u>+5%</u>
Ambient air temperature	<u>+1° C (+2° F)</u>
Test thermocouples' temperature	<u>+1° C</u>
Total elapsed time	<u>+2 minutes</u>

## 3. REQUIRED TEST CONDITIONS.

### 3.1 Arrival Inspection Tests.

a. Determine and record the weight and cubage, as applicable, for the following:

- (1) Total shipping package (contains test item and accessory equipment)
- (2) Individual test item transport packages (test item, accessory equipment)

NOTE: The cubage of irregularly shaped components will be considered the smallest parallelepiped into which the component can fit.

b. Record the shipping package(s) coding for the applicable code marking, in accordance with TOP 1-2-504<sup>1\*\*</sup>, including the following:

- (1) Contractor's name
- (2) Number and date of contract
- (3) Date of manufacturer
- (4) Type of tent or shelter

c. Visually inspect the shipping package(s) and test item, and record the following:

- (1) Any damage to the shipping package(s)
- (2) Any damage to the test item or its accessory equipment including:
  - (a) Test item tears, broken accessories
  - (b) Test item material deterioration
  - (c) Manufacturing defects
  - (d) Effects of moisture, spillage, mildew, or insect attack

\*Values can be assumed to represent  $\pm 2$  SD; thus, the stated tolerances should not be exceeded in more than 1 measurement of 20.

\*\*Footnote numbers correspond to reference numbers in Appendix A.

- (3) Evidence of wear
- (4) Shortages, such as:
  - (a) Missing accessories
  - (b) Missing tools
  - (c) Missing instructions

d. Photograph the following:

- (1) Evidence of damage
- (2) Manufacturer's labels and instructions (operating and maintenance) attached to the test item.

3.2 Physical Characteristics. Determine the following about the test item:

a. Physical dimensions, as applicable, including length and width of floor space; height of the roof at all significant points; height, width, type and number of operational doors, personnel doors, and windows and size, location and number of heater duct openings, vents, and other designed openings.

b. Physical specifications, as applicable

c. Material physical and chemical characteristics, as applicable.

4. TEST PROCEDURES. During each phase of the test, test samples of three, if possible, shall be used.

4.1 Erection and Striking. Erection and striking (paragraphs 4.1.1 and 4.1.2) shall be performed on flat turf with no precipitation, a maximum wind of 16 km/hr (10 mph) and moderate temperature (10° to 32° C [50° to 90° F]).

4.1.1 Erection. Erect the test item, starting with the test item packed for transport, as specified in the applicable instruction manual, and record the following:

- a. Test site wind velocity
- b. Difficulties encountered, as applicable:
  - (1) Unpacking the test item
  - (2) Assembling the frame
  - (3) Anchoring the test item
  - (4) Assembling the vestibule
  - (5) Installing necessary equipment
- c. Time required, as applicable:
  - (1) To unpack the item
  - (2) To assemble the frame
  - (3) To assemble the vestibule
  - (4) To anchor the test item
  - (5) To install accessory equipment
  - (6) For complete assembly (start of unpacking to ready for use)



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- d. Accessory equipment installed
- e. Adequacy of instruction manual
- f. Adequacy of supplied tools
- g. Additional required tools
- h. Adequacy of training requirements

4.1.2 Striking. Strike the test item, as specified in the instruction manual, and record the following:

- a. Test site wind velocity
- b. Difficulties encountered, as applicable
  - (1) Removing accessory equipment
  - (2) Disassembling the vestibule
  - (3) Disassembling the frame
  - (4) Removing the anchoring stakes from the ground
  - (5) Packing the test item for transport
- c. Time required, as applicable
  - (1) To remove accessory equipment
  - (2) To disassemble the vestibule
  - (3) To disassemble the frame
  - (4) To pack the test item for transport
  - (5) For complete striking (start of removal of accessory equipment to ready for transport).

4.1.3 Adverse Wind Conditions. Repeat paragraphs 4.1.1 and 4.1.2 with a wind velocity between 16 and 32 km/hr (10 and 20 mph).

4.1.4 Adverse Soil Conditions. Repeat paragraphs 4.1.1, 4.1.2, and 4.1.3 with the following soil conditions:

- a. Sandy
- b. Rocky
- c. Bare

4.1.5 Adverse Environmental Conditions. Repeat paragraphs 4.1.1 through 4.1.4 as applicable, under the following conditions:

- a. Moderate temperature
  - (1) Rainfall in turf
  - (2) Rainfall in sand
- b. Cold temperature
  - (1) Snow on sand; bare soil
  - (2) Record hand wear used

## c. Frigid temperature

- (1) Frozen turf
- (2) Crusted sand
- (3) Record hand wear used

4.2 Structural Stability Tests. Determine how much wind the unoccupied test item can withstand without suffering damage as follows:

NOTE: Take movies to show the test item's performance under high wind conditions.

## 4.2.1 Wind Machine Tests.

4.2.1.1 Continuous Wind Tests. Determine the effects of a continuous wind as follows:

- a. Erect the test item under normal field conditions on flat turf.
- b. Subject the side of the test item containing the primary entrance to wind machine winds of 48 km/hr (30 mph) for 30 minutes. Record any damages incurred.
- c. If no damage occurred, apply winds in increments of 8 km/hr (5 mph), for 30 minutes to the test item side of step b until damage has occurred, or until the maximum specified/achievable wind velocities have been obtained (see reference 2). Record the damage incurred, wind velocity, and length of time wind was applied.
- d. Repeat steps a through c with the wind applied on a side 90° to the right of the primary entrance.
- e. Repeat steps a through d with the wind applied on the corner formed by the sides of step b and c.
- f. Repeat steps b through e with the test item erected on the following soil:
  - (1) Sandy
  - (2) Rocky
  - (3) Bare

4.2.1.2 Gust Tests. Determine the effects of gusts as follows:

- a. Erect the test item under normal conditions on flat turf.
- b. Subject the side of the test item containing the primary entrance to a continuous wind of 32 km/hr for 10 minutes.
- c. Apply a gust of wind, equal to the damaging wind of paragraph 4.2.1.1 for 2 minutes. Record any damage incurred.
- d. Repeat steps a through c with the wind applied on the side of the test item 90° to the right of the primary entrance.

e. Repeat steps a through c with the wind applied to the corner formed by the sides of step b and step d.

f. Repeat steps b through e with the test item erected on the following soil:

- (1) Sandy
- (2) Rocky
- (3) Bare

#### 4.2.2 Natural Wind Tests.

a. Erect the test item under normal field conditions on flat turf with the primary entrance facing north.

b. Perform the following when periods of high winds are forecast:

- (1) Install an anemograph to measure the wind velocity.
- (2) Install a wind vane and recording equipment to measure the wind direction.

c. Obtain the following during the period of high winds:

- (1) Continuous timed record of wind speed (including gusts)
- (2) Continuous timed record of wind direction

d. Record the following when damage occurs:

- (1) Type of damage
- (2) Location of damage
- (3) Time damage occurred

NOTE: Timing shall commence with the onset of continuous winds of 32 km/hr or greater.

e. Repeat steps a through d with the test item erected in the following soil:

- (1) Sandy
- (2) Rocky
- (3) Bare

#### 4.3 Blackout Tests.

a. Erect the test item under normal field conditions on an open grassy field with a completely unobstructed view for at least 250 m (820 ft).

b. Deploy markers along eight 45° radii around the test item at distances of 250, 200, 150, 100, 50, 20, and 10 m (820, 656, 492, 328, 164, 66, and 33 ft) from the test item's centerpoint (see fig. 1).

c. On a moonless night, perform the following, as applicable:

(1) Operate a bare 100-watt incandescent lamp, at rated wattage, anywhere in a plane 0.3 m (1 ft) from the outside wall and roof surfaces of the test item.

(2) Securely close all doors, windows, and ventilation flaps. No rays of light shall be seen by an observer stationed inside the darkened closed test item, as the lamp is moved outside and around the test item.

d. Personnel (at least two) with normal vision shall traverse a circle 9 m (30 ft) from the tent, and shall record any points where light leakage is observed. When the leakage is determined to be the result of improper test item erection, correct the problem.

e. Five observers with 20/20 vision will be dark-adapted for at least 30 minutes before testing begins. The observers will wear red filter goggles providing low luminance ( $0.07-0.34 \text{ cd/m}^2$ ) red light greater than 620 nm in accordance with MIL-STD-1472C<sup>3</sup>, para 5.2.1.1. At each of the eight 45° radii 250 m from the test item, the five observers will remove their goggles upon command from the test director, and view the test item for 15 seconds. They will then be instructed to put the goggles back on, and the test director will privately ask each observer whether he/she saw light. (Each observer must remain unaware of the others' answers.) Each observer will participate in four of these observation trials (two with the light in the test item turned on, and two with it off) in counterbalanced order. Repeat this procedure along the eight radii at 200, 150, 100, 50, 20, and 10 m. It is essential that good communication be established between the test director and the person who turns the light on and off inside the test item. It is also essential that the counterbalanced presentation be established before testing, and be strictly followed in order to allow proper scoring of the trials. A sample presentation is shown in Table 1.

f. Repeat steps a through e under the following soil conditions, when possible:

- (1) Sandy
- (2) Rocky

g. Measure ambient illumination adjacent to the test item hourly during testing.

h. Measure the irradiance of the light leaks that allow detectability, and note their location.

i. Analyze the data in terms of percent correct response versus distance and viewing angle.



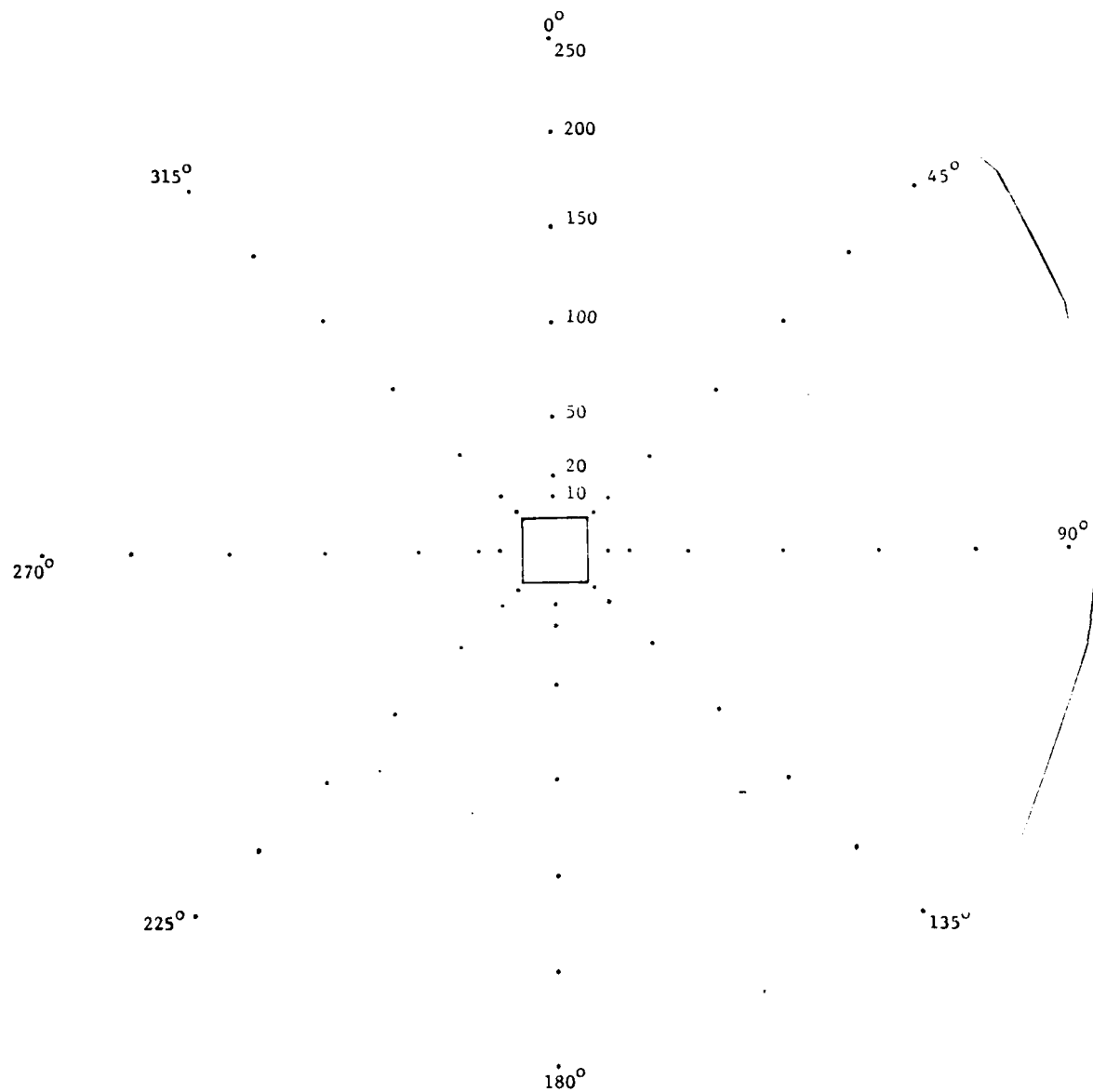


Figure 1. Blackout test setup.

TABLE 1. TRIAL PRESENTATION FOR BLACKOUT TEST.

View Angle (°)	Trial	Light on/off at Viewing Distance (m)						
		250	200	150	100	50	20	10
0	1	on	off	off	on	on	off	off
	2	off	off	on	on	off	off	on
	3	on	on	off	off	on	on	off
	4	off	on	on	off	off	on	on
45	1	off	off	on	on	off	off	on
	2	off	on	on	off	off	on	on
	3	on	off	off	on	on	off	off
	4	on	on	off	off	on	on	off
90	1	off	on	on	off	off	on	on
	2	on	on	off	off	on	on	off
	3	off	off	on	on	off	off	on
	4	on	off	off	on	on	off	off
135	1	on	on	off	off	on	on	off
	2	on	off	off	on	on	off	off
	3	off	on	on	off	off	on	on
	4	off	off	on	on	off	off	on
180	1	on	off	off	on	on	off	off
	2	off	off	on	on	off	off	on
	3	on	on	off	off	on	on	off
	4	off	on	on	off	off	on	on
225	1	off	off	on	on	off	off	on
	2	off	on	on	off	off	on	on
	3	on	off	off	on	on	off	off
	4	on	on	off	off	on	on	off
270	1	off	on	on	off	off	on	on
	2	on	on	off	off	on	on	off
	3	off	off	on	on	off	off	on
	4	on	off	off	on	on	off	off
315	1	on	on	off	off	on	on	off
	2	on	off	off	on	on	off	off
	3	off	on	on	off	off	on	on
	4	off	off	on	on	off	off	on

4.4 Illumination Tests. Determine the adequacy of the level of illumination within the test item, using natural and artificial lights as follows:

a. Erect the test item under normal field conditions on an open area, observing the following conditions:

- (1) With the test item's primary entrance facing in a northerly direction.
- (2) With sufficient space around the test item to prevent its being shaded by other test items or objects.
- (3) With test item empty of all but its normal lighting facilities.

b. Prepare the inside of the test item for testing as follows:

(1) Determine the center of the test item by marking the intersection of diagonal lines laid out between the outside corners of the test item as indicated in Figure 2, and mark it as position No. 1.

(2) Determine test positions No. 2, 3, 4, and 5 by constructing a rectangle whose corners are one-half the distance between the center of the tent and the tent corners.

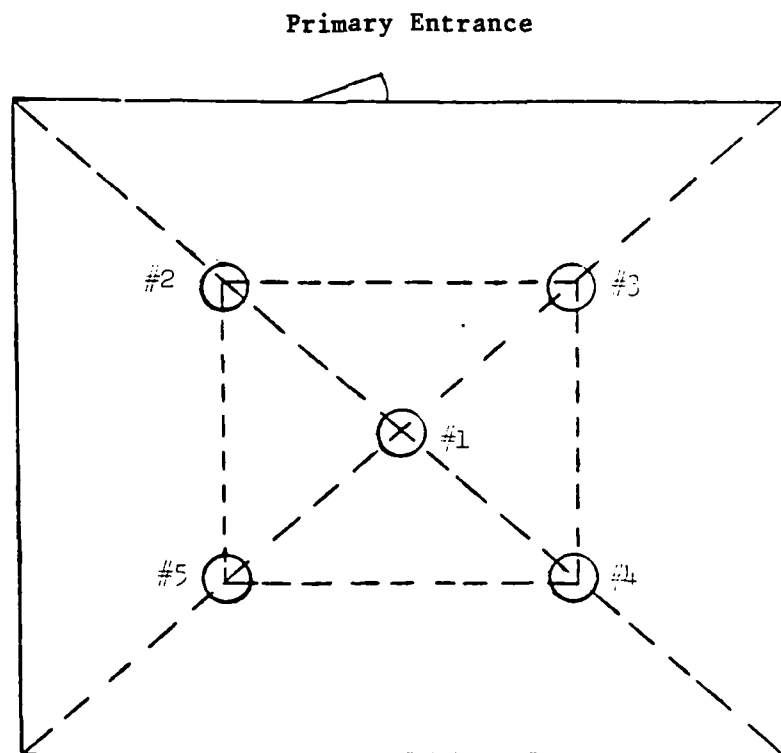


Figure 2. Sample layout showing positions for photometer readings.

c. Use a photo-optically corrected photometer with a cosine receptor to obtain the following measurements:

(1) Place the cosine receptor at a distance of 0.76 m (2.5 ft) above the test item floor, facing upwards at position 1.

(2) Take at least three readings (more if necessary) until a standard deviation of 2 or less is achieved.

(3) Repeat steps (1) and (2) for positions 2,3,4, and 5.

#### 4.4.1 Artificial Lighting Tests (white light only).

a. Turn on the test item's normal lighting.

b. Securely close, as applicable, all windows, doors, and ventilation flaps.

c. Repeat 4.4.c.(1), (2), and (3).

#### 4.4.2 Natural Light Tests.

a. Open all doors, windows and ventilation flaps.

b. On a clear sunlit day, record the test item's light level as indicated in paragraph 4.4c.

c. Repeat step b on an overcast day.

4.4.3 Data Analysis. Compare data obtained from this evaluation to appropriate sections of MIL-STD-1472C.

4.5 Heating Tests. The test item(s) shall be unoccupied during testing. Combustion products shall be monitored/tested before personnel enter.

#### 4.5.1 Heat Retention Tests (vents closed).

a. Erect the test item(s) under normal field conditions, in accordance with appropriate technical manuals.

b. Before all tests, inspect all components for serviceability.

c. Install instrumentation and allow to stabilize.

(1) Record relative humidity hourly.

(2) Install thermocouples at each corner, 0.3 m from the structural walls (see fig. 3).

(3) Height of wall thermocouples will depend on shelter design. If the wall is perpendicular to the ground and roof, place thermocouples 1.2 m (47 in.) or higher, maintaining the same height for each corner thermocouple. If walls or ceiling slope, place the thermocouples on a level with the top of the wall or 1.2 m, whichever is greater (see fig. 4).

(4) Place additional thermocouples in the center of the shelter: two at 10 cm above the ground (foot level), two at 0.9 m (3 ft) (hand level), and two at 1.8 m (6 ft) (head level).

(5) Ambient weather conditions:

- (a) Temperature
- (b) Wet bulb temperature
- (c) Wind velocity

d. Direct heat into the shelter from a source (as specified in requirements documents, or if none specified, a Herman Nelson or Master Heater).

e. Close vents, windows, and doors for heat retention testing.

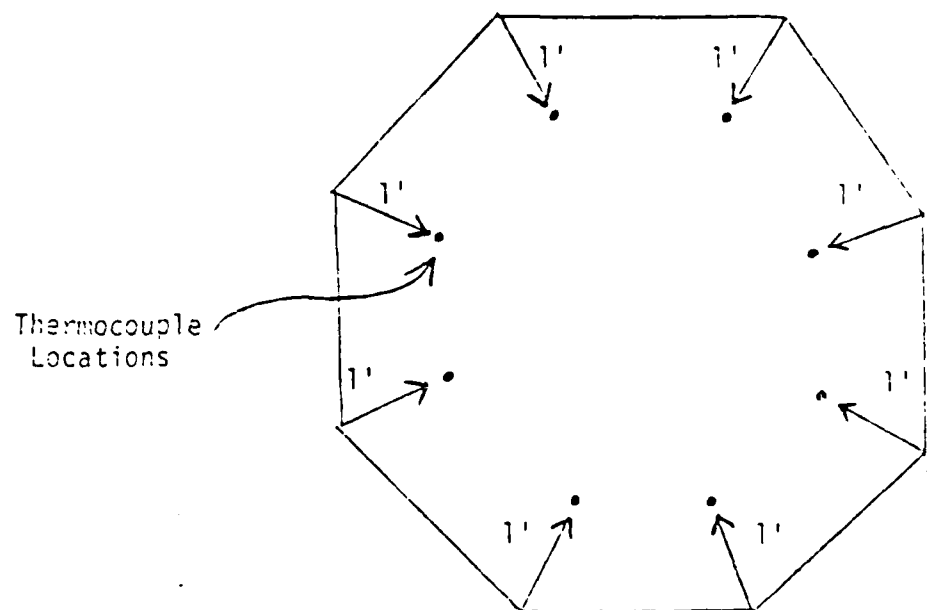
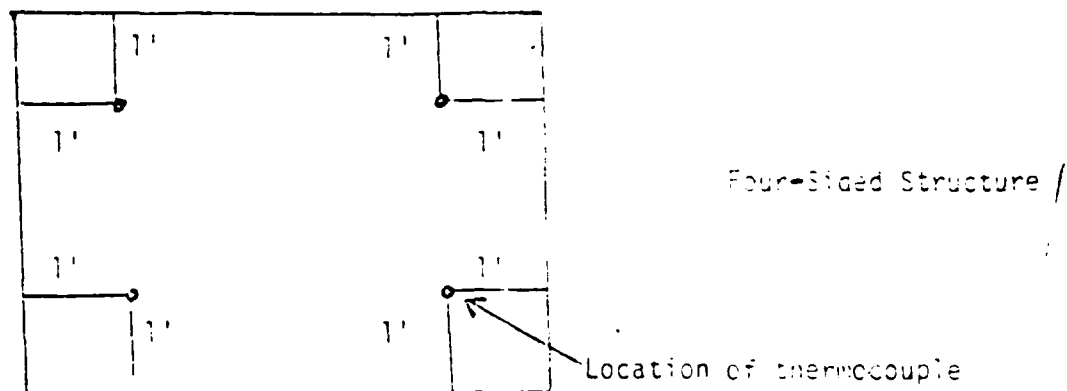


Figure 3. Thermocouple locations.

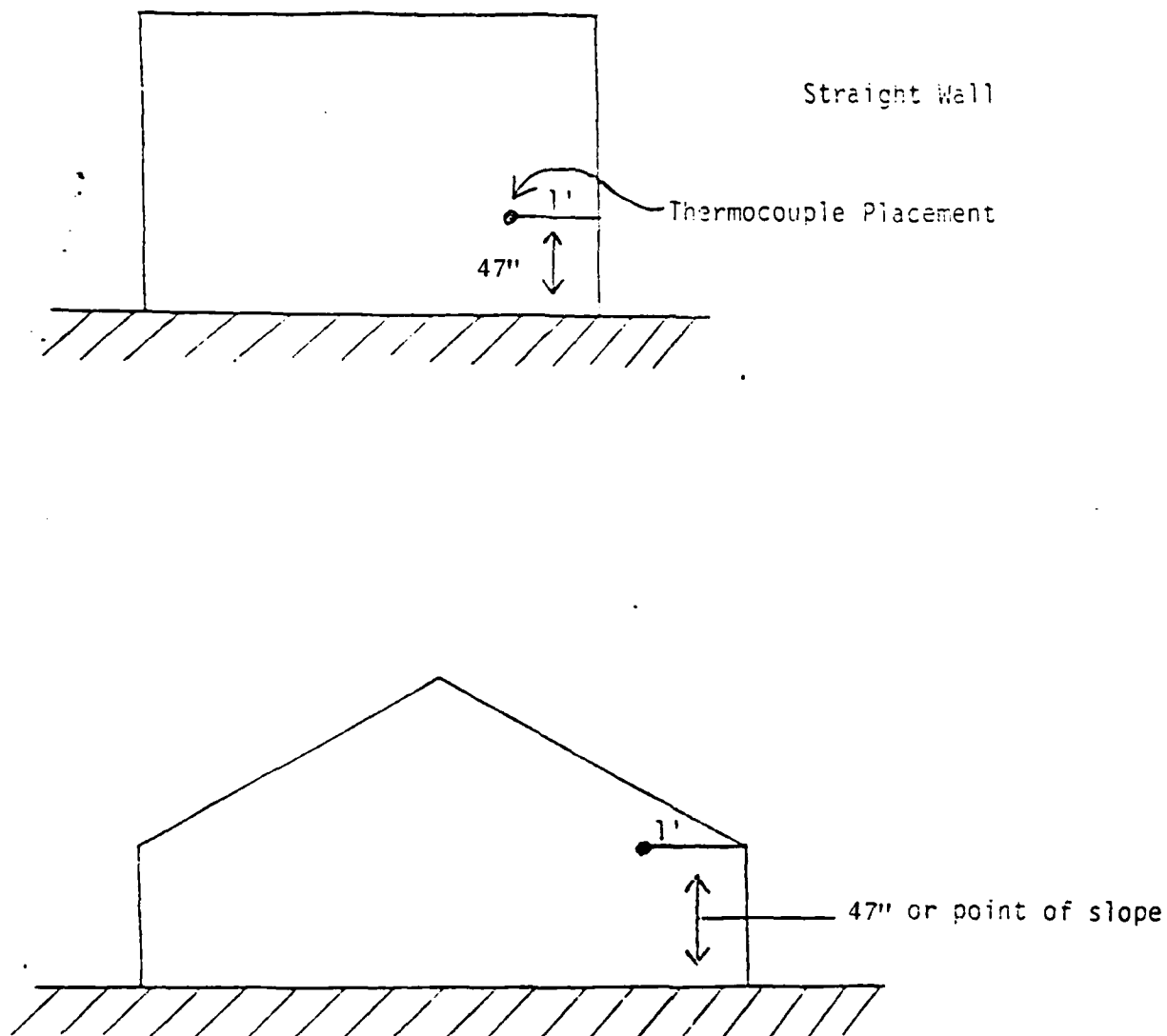


Figure 4. Thermocouple placement.

f. Upon achieving a stable temperature at foot, hand, and head positions (three consecutive  $\pm 1^\circ$  C readings 5 minutes apart), turn on heaters and allow them to run until hand level temperature stabilizes or exceeds  $24^\circ$  C ( $75^\circ$  F).

g. Upon achieving a stable hand level temperature, turn off heaters. Monitor temperatures at 1-minute intervals to ensure enough data-collection points to compare to other test items.

h. Use temperatures at hand level to determine cool-off time. Terminate the test when the hand level temperature stabilizes (15 minutes of consecutive temperatures  $\pm 1^\circ$  C) or after 1 hour has elapsed.

i. Compare all data points to determine heat retention of each structure.

j. Conduct all testing during periods of minimum solar radiation.

k. Use temperature design categories C1 and C2 of AR 70-38<sup>4</sup> whenever possible.

#### 4.5.2 Heat Retention Tests (vents open).

Conduct the following procedures (with ventilation flaps open) during darkness to prevent solar heating, with doors and windows securely closed and a maximum ambient temperature of  $0^\circ$  C ( $32^\circ$  F).

a. Immediately before igniting the heaters, record the following:

- (1) Weight of the fuel cans
- (2) Temperature within the test item at all positions
- (3) Relative humidity of the test item as indicated by hygro-thermograph
- (4) Ambient weather conditions:

- (a) Temperature
- (b) Wet bulb temperature
- (c) Wind velocity

b. Ignite the heaters, and adjust controls for maximum capacity.

c. Operate the heaters at maximum capacity until a temperature of  $21^\circ$  C ( $70^\circ$  F) at the hygro-thermograph is achieved; adjust the heater controls to stabilize the test item temperature at  $21^\circ$  C.

NOTE: Stabilization is achieved when the temperature within the test item does not change more than  $\pm 1^\circ$  C ( $\pm 2^\circ$  F) per hour.

d. Operate the heaters for 3 hours after stabilization has been achieved.

e. Record the following:

- (1) Time heaters were ignited
  - (2) Every half hour during test
- (a) Ambient temperature
  - (b) Ambient wet bulb temperatures



- (c) Wind velocity
- (d) 1.2-m level temperature readings at thermometer positions 1 through 5.
- (e) Vertical thermocouple temperature readings at floor level, test item top, and at 0.3, 0.6, 0.9, 1.5, and 2.1 m above floor level.
- (f) Test item relative humidity as indicated by the hygro-thermograph.

- (3) Time required from fuel ignition to reach 21° C at the thermograph.
- (4) Time required from fuel ignition to reach temperature stabilization, at the thermograph.
- (5) Weight of fuel supply cans when the temperature has been stabilized.
- (6) Heater control settings to maintain temperature stabilization.
- (7) Following temperature readings when stabilization is achieved:

(a) Corner 1.2-m level temperature at positions 2 through 5.

(b) Vertical temperature at floor level, test top level, 0.3, 0.6, 0.9, 1.5, and 2.1 m above floor level.

4.6 Test Chamber Water Resistance Tests. Determine the comparative water resistance of the test item by performing the following procedures:

a. Erect the test item using normal field conditions, in a static rain course.

NOTE: The rain course should cover an area 11 by 15 m (36 by 50 ft) and be capable of simulating any rain condition from a slight drizzle (2.5 mm (0.1 in.) of rain per hour) to a torrential downpour of 76 mm (3 in.) of rain per hour by means of high-pressure showerheads projecting from parapets 9 m (30 ft) above the course floor.

b. Subject dry test items to a 5-hour period of rainfall at the rate of 25 mm per hour.

c. Inspect the test item each half hour, and record the location area and intensity of all leakage.

NOTE 1: Two observers working independently of each other shall make the half-hourly inspections.

NOTE 2: Record fabric leakage, seam leakage, and wicking of the sewing thread separately.

NOTE 3: Note intensity of leakage as follows:

- (a) Negligible leakage - damp spots, barely noticeable
- (b) Minor leakage - droplets forming on the fabric or at the seams and hanging there (no movement of water) which under ordinary circumstances will not impair the test item's intended military use.
- (c) Major leakage - water continually leaking and dropping off or running down the test item's inner surface which impairs the test item's intended military use.

- d. Retain the test items on the rain course until they are completely dry.
- e. Subject the dried test items to a 5-hour period of rainfall at the rate of 76 mm per hour.
- f. Repeat step c.

4.7 Durability. At all times when the items are not required for some specific test, they will remain erected for exposure to prevailing weather conditions. During this time, the test item shall be subject to the following:

4.7.1 Routine Inspection Checks.

a. Each morning: Inspect the test item to ensure guy lines and anchoring devices are according to specifications. Repair slack guy line and/or loose anchoring devices, and record the repairs required and failure influencing factors.

b. Each week: Inspect the test item for fabric tears, frayed guy lines, cracked fabric, etc. Record areas of failure and repairs made and failure-influencing factors.

NOTE: Photograph damaged areas with still and movie cameras, as applicable.

4.7.2 Moisture Penetration Tests. During each period of extended rain or snowfall, determine the test item's ability to prevent leakage, snow entry, and water accumulation as follows:

- a. Record the following when precipitation commences:

- (1) Length of time the test item has been exposed to the weather
- (2) Type of test site terrain
- (3) Time precipitation commenced
- (4) Type of precipitation
- (5) Average wind velocity and direction
- (6) Ambient temperature

b. Record the following each half hour, for periods of at least 5 hours beginning when precipitation begins.

NOTE: When precipitation is expected to last more than 12 hours, data can be recorded in 10-hour blocks (5 hours recording, 5 hours non-recording) until the precipitation stops. Record time when precipitation stops, whether during recording or non-recording period.

(1) Presence, location, and amount of water accumulation due to seepage, in the test item.

(2) Presence, location, and amount of snow entry in the test item.

NOTE: Note amount of water accumulation and snow entry as follows:

- (a) Slight - barely noticeable
- (b) Medium - small accumulation; does not impair the test item's military use.

(c) Heavy - large accumulation; interferes with the test item's military use.

(3) Presence, type, location and intensity of water leakage.

NOTE: Type and intensity of water leakage are described in paragraph 4.6.

(4) Extent of frost coverage, when applicable, on the test item.

c. Diagram the positions of water accumulation, snow entry, and frost coverage.

4.7.3 Sand and Dust Tests. During periods of no precipitation when the test item is not undergoing specific tests, indicate its ability to prevent the entrance of sand and dust as follows:

- a. Securely close all doors and windows
- b. Record the following:

- (1) Test site terrain
- (2) Presence of sand or dust in the test item
- (3) Minimum wind required to blow sand and dust into test item, if capable
- (4) Location where sand/dust enter, if capable

4.7.4 Wind Tests. During periods of no precipitation when the test item is not undergoing specific tests, indicate its ability to prevent winds entering the test item as follows:

- a. Securely close all doors, and windows.
- b. Record the following:
  - (1) Test site terrain
  - (2) Presence of a draft
  - (3) Minimum wind required to cause a draft
  - (4) Location of wind entry point

4.8 Environmental Tests. Environmental tests under desert, arctic, and tropic conditions shall be performed as described in MIL-STD 810D.<sup>5</sup>

4.9 Human Factors. Conduct human factor tests and considerations in accordance with TOP 1-2-610.<sup>6</sup>

4.10 Logistic Supportability. Conduct testing in accordance with TECOM Suppl 1 to DARCOM-R 700-15. During all testing, record the following:

- a. Scheduled maintenance operations as directed by the manufacturer's instruction.
- b. Equipment deficiencies and possible causes.
- c. Adequacy of the interchangeability of parts for replacement operations.
- d. Adequacy and accuracy of the technical and maintenance instructions provided by the manufacturer.

4.10.1 Reliability. Test in accordance with AR 702-3<sup>8</sup> and applicable requirements documents.

4.10.2 Transportability. Test in accordance with TOP 1-2-500.<sup>9</sup>

4.11 Safety. During all testing, examine the test item and its accessory equipment to ensure the following:

a. Electrical devices meet all the requirements for operation in hazardous locations as specified in Volume V of the National Fire Code.

b. Heating system fumes are not dangerous to personnel

c. Sufficient ventilation is provided for the personnel

d. Tent fabric is not injurious due to toxicity, etc.

e. Tent, tent supports and accessories do not contain inherent hazards such as exposed sharp edges, guy wires which interfere with normal operation, inadequate safeguards around the heating unit.

5. DATA REQUIRED. Record the following:

5.1 Arrival Inspection Tests.

a. Total shipping package weight and cubage

b. Individual test item transport packages weight and cubage

(1) Test item

(2) Accessory equipment

c. Coding and legibility (clear, unclear)

d. Coding

(1) Contractor's name

(2) Number and date of contract

(3) Date of manufacture

(4) Type of tent or shelter

e. Damages:

(1) To shipping packages

(2) To test item and/or accessories

f. Evidence of wear

g. Shortages

5.2 Physical Characteristics. Record data as described in the applicable portion of TOP 1-2-504.

5.3 Erection and Striking. For each test item:

a. Test item number (1, 2, or 3)

b. Test site terrain (turf, sand, etc.)

c. Test site temperature, in °C

d. Test site weather condition (clear, rain, snow)

- e. Test site terrain condition (wet, frozen, dry, etc.)
- f. Hand wear used (gloves, arctic mittens, none)

5.3.1 Erection. For each erection:

- a. Test site wind velocity
- b. Difficulties encountered, as applicable:
  - (1) Unpacking the test item
  - (2) Assembling the frame
  - (3) Anchoring the test item
  - (4) Assembling the vestibule
  - (5) Installation of accessory equipment
- c. Time required in minutes, as applicable
  - (1) To unpack the test item
  - (2) To assemble the frame
  - (3) To assemble the vestibule
  - (4) To anchor the test item
  - (5) To install accessory equipment
  - (6) For complete assembly
- d. Accessory equipment installed (light fixtures, desks, tables, etc.)
- e. Adequacy of instruction manual
- f. Adequacy of supplied tools
- g. Additional tools required (ladders, etc.)
- h. Adequacy of manning schedule (enough, too many, too few).

5.3.2 Striking. For each strike:

- a. Test site wind velocity
- b. Difficulties encountered, if applicable:
  - (1) Removing accessory equipment
  - (2) Disassembling the vestibule
  - (3) Disassembling the frame
  - (4) Removing the anchoring stakes
  - (5) Packing the test item for transport
- c. Time required in minutes, as applicable:
  - (1) To remove accessory equipment
  - (2) To disassemble the vestibule
  - (3) To disassembly the frame
  - (4) To remove the anchoring stakes
  - (5) For complete striking

5.4 Structural Stability Tests. For each test item:

- a. Test item number (1, 2, 3)
- b. Test site terrain (turf, sand etc.)

5.4.1 Wind Machine Tests.

## 5.4.1.1 Continuous Wind Tests. For each side tested:

- a. Side under test (primary entrance, corner, right side of test item)
- b. Wind gust velocity causing damage
- c. Damage incurred

## 5.4.2 Natural Wind Tests.

- a. Average wind velocity
- b. Maximum gust velocity
- c. Direction of wind (from east, south, etc.)
- d. Damage incurred
- e. Time required for damage, in minutes

5.5 Blackout Tests. For each test item:

- a. Test item number (1, 2, 3)
- b. Test site terrain (terrain (turf, rock etc.)
- c. Observer number (1 or 2)
- d. Maximum distance at which light can be observed (183 m, 46 m, etc.)

5.6 Illumination Tests

## 5.6.1 All Lighting Tests. For each test item:

- a. Test type (artificial or natural)
- b. Test item number (1, 2, 3)
- c. Photometer readings, in foot-candles

## (1) At position No. 1 as follows:

- (a) Sensing element in a horizontal plane facing upwards
- (b) Sensing element in a vertical plane facing:

Position No. 2  
Position No. 3  
Position No. 4  
Position No. 5

## (2) At position No. 2 as follows:

- (a) Sensing element in a horizontal plane facing upwards
- (b) Sensing element in a vertical plane facing:

Position No. 1  
180° from position No. 1

## (3) At position No. 3 as follows:

- (a) Sensing element in a horizontal plane facing upwards
- (b) Sensing element in a vertical plane facing:

Position No. 1  
180° from position No. 1

(4) At position No. 4 as follows:

- (a) Sensing element in a horizontal plane facing upwards
- (b) Sensing element in a vertical plane facing:

Position No. 1  
180° from position No. 1

(5) At position No. 5 as follows:

- (a) Sensing element in a horizontal plane facing upwards

Position No. 1  
180° from position No. 1

5.6.2 Natural Lighting Only. Outside lighting levels, in foot-candles as follows:

a. Sensing element in a horizontal plane facing upwards

- (1) North
- (2) North-East
- (3) East
- (4) South-East
- (5) South
- (6) South-West
- (7) West
- (8) North-West

5.7 Heating tests. For each test item:

- a. Test item number (1, 2, 3)
- b. Before testing:

(1) Ambient weather conditions:

- (a) Temperature in °C
- (b) Wet bulb temperature in °C
- (c) Wind velocity

(2) Test item temperature, in °C at:

(a) Test item center at the following heights, as applicable:

- (1) Floor level
- (2) 1 ft level
- (3) 2 ft level
- (4) 3 ft level
- (5) 4 ft level
- (6) 5 ft level
- (7) 7 ft level
- (8) Test item top

(b) Corner positions

- (1) Position 2
- (2) Position 3
- (3) Position 4
- (4) Position 5

(3) Relative humidity in percent from hygro-thermograph

- c. Time heaters are ignited in day, hour, and minute
- d. Each half hour during test:

- (1) Time, in day, hour, and minute
- (2) Ambient weather conditions:

- (a) Air temperature in °C
- (b) Wet bulb temperature in °C
- (c) Wind velocity

(3) Test item temperature in °C at:

(a) Test item center at the following heights, as applicable:

- (1) Floor level
- (2) 1 ft level
- (3) 2 ft level
- (4) 3 ft level
- (5) 4 ft level
- (6) 5 ft level
- (7) 7 ft level
- (8) Test item top

(b) Corner Positions

- (1) Position 2
- (2) Position 3
- (3) Position 4
- (4) Position 5

(4) Relative humidity in percent from hygro-thermograph

- e. Time required to reach 21° C, in minutes
- f. Time required to reach stabilization, at thermograph in minutes
- g. Weight of fuel supply cans when stabilization is reached.
- h. Heater control settings to maintain stabilization
- i. Test item temperature in °C at the following points when stabilization is achieved.

j. Test thermocouples' temperatures every 5 minutes to stabilization and every minute while monitoring

(1) Test item center at the following heights, as applicable:

- (a) Floor level
- (b) 1 ft level
- (c) 2 ft level



- (d) 3 ft level
- (e) 5 ft level
- (f) 7 ft level
- (g) Test item top

(2) Corner positions:

- (a) Position 2
- (b) Position 3
- (c) Position 4
- (d) Position 5

5.8 Test Chamber Water Resistance Tests. For each test item:

- a. Test item number (1, 2, 3)
  - b. Test type (25 mm rain per hour, 76 mm rain per hour)
  - c. Each half hour during test for each observer
- (1) Observer number (1, 2)
  - (2) Type leakage, location, and intensity of leakage, if any:
    - (a) Fabric leakage:
      - Location
      - Intensity (negligible, minor, major)
    - (b) Seam leakage:
      - Location
      - Intensity
    - (c) Wicking leakage:
      - Location
      - Intensity

5.9 Durability Test.

Test item number (1, 2, 3)

5.9.1 Routine Inspection Checks.

- a. Each morning:
  - (1) For each test item:
    - (a) Date, in day, month, year
    - (b) Requirement for repair (yes, no)
    - (c) Type of repair, when required (loose guy wire)
    - (d) Influencing factors (high winds)
- b. Each week:
  - (1) For each test item:

- (a) Date, in day, month, year
- (b) Requirement for repair (yes, no)
- (c) Type of repair, when required (torn door flap)
- (d) Influencing factors (abnormal traffic)

(2) Retain photographs

#### 5.9.2 Moisture Penetration Tests.

a. For each time precipitation occurs during test:

- (1) Total time test item has been exposed to weather, in days.
- (2) Type of test terrain (sand, turf, etc.)
- (3) Time precipitation commenced or ceased (day, hour, minute)
- (4) Type of precipitation (rain, snow)
- (5) Number of times test item has been exposed (2nd, 5th)
- (6) Average wind velocity and direction
- (7) Ambient temperature

b. Record the following each half hour during observing periods, as applicable:

- (1) Time of observation (day, hour, minute)
- (2) For water seepage:
  - (a) Presence of water seepage
  - (b) Location
  - (c) Amount of accumulation (slight, medium, heavy)
- (3) For snow entry:
  - (a) Presence of snow entry
  - (b) Location
  - (c) Amount of accumulation (slight, medium, heavy)
- (4) For each type of leakage:
  - (a) Type of leakage (fabric, seam, wicking)
  - (b) Location
  - (c) Amount (negligible, minor, major)
- (5) For frost:
  - (a) Location
  - (b) Extent, in area

c. Retain diagrams indicating location of seepage, snow entry, and frost.

#### 5.9.3 Sand and Dust Tests. For each test item:

- a. Type of test terrain (sand, turf, etc.)
- b. For presence of sand or dust:

- (1) Entrance locations
- (2) Minimum wind velocity when sand or dust enters test item, if able.

5.9.4 Wind Tests. For each test item:

- a. Type of test terrain (sand, turf, etc.)
- b. For presence of drafts
  - (1) Entrance locations
  - (2) Minimum wind velocity that causes drafts

5.10 Environmental Tests (arctic, desert, and tropic). Use procedures contained in MIL-STD 810D. Record the Following:

- a. Type exposure
- b. Test temperatures
- c. Duration of exposure
- d. Test item configuration
- e. Humidity (when appropriate)
- f. Solar radiation (when appropriate)
- g. Critical item components
- h. Additional data to satisfy equipment specifications or requirements documents

5.11 Human Factors. Data as described in TOP 1-2-610.

5.12 Logistic Supportability.

- a. For scheduled maintenance
  - (1) Time of maintenance (day, month, year)
  - (2) Type of maintenance (weekly, monthly, etc.)
  - (3) Procedures performed
  - (4) Equipment or material deficiencies and causes, if possible
  - (5) Adequacy and accuracy of technical and maintenance instructions
- b. Adequacy of the interchangeability of parts for replacement operations.

5.13 Safety. Refer to the DARCOM Safety Manual.<sup>10</sup>

- a. Conditions that do not meet the standards of The National Fire Code
- b. Heating system deficiencies (none, eye irritating fumes, etc.)
- c. Ventilation condition (good, insufficient)
- d. Tent fabric safety condition (good, flammable, toxic, etc.)
- e. Overall safety conditions (good, tent entrance too low, etc.)

6. DATA PRESENTATION. Summarize and evaluate data obtained for each performance characteristic for each tent tested. Use appropriate charts and graphs to summarize test data. Give special consideration to any condition or circumstance that may have contributed to any test result.

Determine time required to erect and strike each tent by averaging the times required by all crews of a given size. Record the size crew with the lowest

average time as the maximum size crew required to erect and strike the tent. Record the smallest crew that can successfully erect and strike the tent as the minimum size crew. The optimum size crew will normally be between the minimum and maximum size crews. Determine the optimum size crew by evaluating the performance of individual crew members and by evaluating the data for all crews. The optimum time required will be the average time required for the optimum size crew.

For illumination characteristics of each test tent, average all 33 photometer readings made during each test to determine the mean illuminosity for the tent.

For heating characteristics of each tent, average all readings for each thermometer during each test period. Average these mean temperatures for all thermometers to determine the mean temperature of the tent during each 3-hour test period. Average mean temperature for all test periods to determine the mean test temperature for the tent. Determine fuel consumption by differentially weighing fuel supply containers.

Compare data obtained for each performance characteristic with established performance standards for the tent, or evaluate data obtained for different types of tents undergoing the same test comparatively.

Recommended changes of this publication should be forwarded to Commander, US Army Test and Evaluation Command, ATTN: DRSTE-AD-M, Aberdeen Proving Ground, Md. 21005. Technical information may be obtained from the preparing activity: Commander, US Army Aberdeen Proving Ground, ATTN: STEAP-MT-M, Aberdeen Proving Ground, Md 21005. Additional copies are available from the Defense Technical Information Center, Cameron Station, Alexandria, Va. 22314. This document is identified by the accession number (AD No.), printed on the first page.

## APPENDIX A

## REFERENCES

1. TOP 1-2-504, Physical Characteristics, 31 October 1972.
2. MTD-STD 907A, Engineering and Design Criteria for Shelters, Expandable and Nonexpandable, 31 March 1983.
3. MIL-STD 1472C, Human Engineering Design Criteria for Military Systems, Equipment, and Facilities, 2 May 1981.
4. AR 70-38, Test and Evaluation of Materiel for Extreme Climatic Conditions, 1 August 1979; Change 1, 15 September 1979.
5. MIL-STD-810D, Environmental Test Methods, 19 July 1983.
6. TOP 1-2-610, Human Factors Engineering Data Guide for Evaluation (HEDGE) and Guidebook Supplement to HEDGE, 20 December 1977.
7. TECOM Suppl 1 to DARCOM-R 700-15, Integrated Logistics Support, 20 June 1980.
8. AR 702-3, Army Materiel Reliability, Availability, and Maintainability (RAM), 1 May 1982.
9. TOP 1-2-500, Transportability, 7 February 1973; Change 1, 22 July 1976; Change 2, 24 August 1976; and Change 3, 20 March 1979.
10. DARCOM Safety Manual, Regulation 385-100, 17 August 1981.